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Myofascial trigger point development from visual and postural stressors during computer work

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Abstract

The mechanism of musculoskeletal pain underlying low level static exertions, such as those experienced during computer work, is poorly understood. It was hypothesized that static postural and visual stress experienced during computer work might contribute to trigger point development in the trapezius muscles, resulting in myofascial pain. A study was conducted to observe the development of myofascial trigger points while 16 female subjects used a computer under conditions of high and low postural and visual stress. Trigger point development was monitored via expert opinion, subject self-report, and electromyographic activity. Only the high visual stress conditions resulted in greater trigger point sensitivity as reported by subjects and the myofascial specialist. Cyclic trends in median frequency of the EMG signal were assessed for the trapezius muscle. When high visual stress was combined with low postural stress condition there were significantly fewer cycles (1.6 cycles) as compared to the condition of low visual and low postural stress (2.8 cycles), and the condition of high visual and high postural stress (3.5 cycles). These significant differences between conditions were found for the right trapezius but not for the left. The findings suggest that high visual stress may be involved in the development of the myofascial pain response.

Keywords: Computer work; Electromyography; EMG; Low level static exertions; LLSEs; Myofascial pain; Trapezius muscle; Trigger points; Visual stress

1. Introduction

Musculoskeletal disorders (MSDs) continue to represent a major source of pain and discomfort as well as a significant source of lost workdays and workers' compensation costs. This trend has persisted despite changes in the nature of work driven by a shifting economic base. Over the past decade the manufacturing sector has shrunk in much of the industrialized world and the manufacturing that remains has shifted from heavy to light manufacturing. In addition, service sector jobs have become more prevalent as well as information-based tasks that have made computers virtually ubiquitous in industrialized countries. The World Health Organization [43] estimated that over 60% of the North American workforce used computers. The percent of households in the United States with computers increased from 42% in December 1998, to 51% by August 2000.

Computer work often involves both physical and mental demands. Physical demands are characterized by low force exertions and static postures that are sustained for long durations [8]. Elevated shoulder postures, supported loads, prolonged static contractions and task duration have been identified as computer-related risk factors for neck and shoulder problems [9,21,17,38]. Sustained and repeated muscle activity such as stereotypic computer postures may be responsible for complaints of occupational muscle pain even at very low force levels [19].

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In addition to the physical demands of the job, muscle tension may increase as a subconscious reaction to a stressful situation. Muscle tension may arise from psychological factors or psychosocial stress factors [7]. Psychological factors such as job stress or mentally demanding work has been found to induce sustained muscle activation, particularly in the trapezius muscle [39]. Sustained muscle tension has been associated with the development of clinical disorders such as fibromyalgia [37] or myofascial pain syndromes [44].

Mental stress has been found in computer work [41]. Mental stress may increase the level of muscle tension beyond what is needed for postural stability and motor control of the task. Several studies have linked mental stress with visual discomfort [16,1,2]. Visual discomfort in computer workstations can arise from glare, inadequate lighting, poor screen resolution or text legibility, and flicker/refresh rates of the computer monitor.

Much of the load on the shoulder and neck during computer work, whether from postural or mental demands, can be classified as low level static exertions (LLSEs). LLSEs have been implicated as a risk factor for MSDs [40,34,12,32,42]. There is growing appreciation that the LLSE component imposed upon the shoulders during computer based work may be an important factor in MSD causality. However, little is known about this potential causal pathway.

Traditional ergonomic research has employed a load-tolerance model to understand how injuries occur. This model predicts an injury can occur if the load imposed upon a tissue exceeds the tolerance of that tissue. However, such load-tolerance logic may not apply to the LLSE situation because the muscle as a whole is not functioning near maximum capacity. Skeletal muscle is composed of different fiber types which may not be equally loaded in under low-exertion levels [33]. For this reason, other injury pathways should be considered.

One such pathway may involve myofascial trigger points (MTrPts). Neck and shoulder muscle pain have been attributed to MTrPts [36,31,28]. In particular, the trapezius muscle has been identified as a common site for trigger points [35]. Trigger points are small circular areas of hyperirritability and can be easily felt as small nodules within muscles and fascia [31]. They may contain multiple contraction knots within a taut band of skeletal muscles [36]. Each contraction knot comprises maximally contracted sarcomeres that are much shorter and wider than sarcomeres in normal muscle fibers [31]. Myofascial pain syndrome (MPS) is the term used to refer to the regional muscle pain that is caused by trigger points. Clinical characteristics of MPS include trigger points in a taut band of skeletal muscle, local twitch response, referred pain, restricted movement, weakness and autonomic dysfunction [15]. These symptoms resemble many of the MSD symptoms that result from LLSEs. It is possible that MPS may represent a pathway to pain associated with LLSE tasks. MPS has been studied in the fields of dentistry [29], headache research [23,22,20,4,10], and physical medicine [6] but has been largely overlooked as a potential source of pain by ergonomists.

Despite the fact that MTrPts are "clearly an electrophysiological phenomenon" [15], little electromyography has been performed on the trigger points themselves in either the ergonomic or biomechanical literature. Although many EMG studies have been performed on the trapezius muscle, no studies have focused on trigger points. In a review of 74 EMG studies of the trapezius muscle, none had indicated that the surface electrodes were placed in the vicinity of known trigger points [25]. Furthermore, the exquisitely sensitive nature of trigger points posed a technical challenge for recording their electrical activity using traditional EMG methods.

An innovative technique that measured cyclic changes in EMG median frequency was pioneered by McLean and colleagues [26,27]. Spectral shifts to lower frequency have traditionally been attributed to fatigue of the entire muscle that is extrapolated from the electrode pick-up window. However, contemporary theories of muscle fatigue suggest that the load may not be uniformly distributed over all muscle fibers. Rather, some fibers, the so-called "Cinderella fibers" may be selectively overloaded [18]. In order to detect the EMG changes associated with these fibers, a different form of spectral processing was needed. McLean et al. [27] described cyclic trends in the median frequency of postural muscles while the subjects performed computer tasks. They suggested that the median frequency cycles may be due to regulation of motor unit recruitment in order to prevent fatigue. In a related study, they found that more cycles in the median frequency occurred when subjects were given microbreaks during computer work [27].

The purpose of this study was to examine the development of muscle pain and injury under LLSE task conditions. We hypothesized that postural factors, mental stress (represented by visual stressors), and their interaction might impact the development of trigger points. The study focused on MTrPts in the trapezius muscle during the type of low level static exertions that are associated with computer work. Trigger point development was monitored via electromyography (EMG) using frequency cycling, and established independently by responses of the test subjects and by objective evaluation by a myofascial specialist.

2. Methods

2.1. Subjects

Sixteen healthy women (mean = 22.8 years, range = 19–29 years) with no current history of upper extremity disorders were recruited by word-of-mouth